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Incidence of HIV Seroconversion in U.S. Navy and Marine Corps Personnel 1986-1988: Results of Total Screening

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During the period 1986 to 1988, the U.S. Navy and Marine Corps administered 1,956,631 ELISA screening tests for antibodies to the Human Immunodeficiency Virus (HIV) to 1,070,511 active-duty enlisted and officer personnel. This study identified all persons with an initial negative test. This population was then followed and those who later tested positive for HIV were identified as seroconverters. Incidence rates of seroconversion per 1,000 person-years were calculated. There were 582 seroconversions identified from a total of 987,479 person-years at risk. The seroconversion rate and 95 percent Poisson confidence limits for Naval personnel was 0.69 per 1,000 person-years (95% C.I. = 0.63-0.76). Age-adjusted rates in men were 5.0 times those of women. Age-adjusted rates in blacks were 3.7 times those of whites. The age-adjusted seroconversion rate in Marine Corps personnel was 0.28 per 1,000 person-years (95% C.I. = 0.22-0.36). Similar demographic patterns were present in the Marine Corps and the Navy. This study is one of the first reports of incidence of HIV seroconversion by demographic characteristics in a large, young, and apparently healthy population.

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In 1986, the Navy and Marine Corps began routine testing of all personnel for the presence of antibodies to the Human Immunodeficiency Virus (HIV) which is associated with AIDS (1,2). Since this time, approximately 97 percent of active-duty Naval and Marine Corps personnel have had at least one annual HIV screening test (1,956,631 tests, 1,070,511 persons). Since October 1985, all applicants for Naval and Marine Corps service have also been tested (3,4). Prevalence rates of HIV seropositivity for military applicants (5-7) and for active-duty military personnel have been reported (8).

We identified all persons in the active-duty Naval and Marine Corps population with a negative ELISA HIV blood test followed by two positive ELISA tests and two positive Western blot assays at a later date. Person-years at risk were calculated using records of results of all ELISA tests and Western blot assays and career history information. This study reports age-adjusted incidence rates per 1,000 person-years of HIV seroconversion by demographic characteristics in an apparently healthy population.

Methods

All persons testing seropositive for HIV in the Navy and Marine Corps from all sources of testing including service-wide screening, blood screening, and clinical screening are included in a Navy and Marine Corps HIV Central Registry at the Naval Health Research Center (NHRC), San Diego, California and are included in this study. Social security numbers and other identifying information for seropositive personnel were provided to NHRC by the Naval Medical Command, Washington D.C. Demographic information was then obtained for this population through matching with NHRC computerized career history and inpatient records. Career history information was provided by the Naval Medical

Personnel Command and inpatient records by the Naval Medical Data Services Center (9).

Computerized records of all persons receiving HIV tests were used to determine the population at risk for seroconversion. These records are provided to the Naval Health Research Center by the Reportable Disease Database (RDDDB) of the Defense Eligibility Enrollment Reporting System (DEERS), in Monterey, California. Rosters of all persons tested in Navy-wide screening are sent to the RDDDB for data entry from 27 designated Naval testing facilities. The names and social security numbers on these rosters are then verified using career history records (97 per cent of the total Naval and Marine Corps population on the NHRC Career History File were successfully matched with tested personnel identified from rosters).

Incidence rates of HIV seroconversion were calculated using person-years at risk in the denominator (10). The period at risk for each active-duty individual began with the first negative ELISA test and continued until the first positive Western blot assay or the last negative ELISA test. The date

of accession into military service was used as the beginning date for the period at risk for personnel entering the service after 1986. Service applicant testing began in October 1985 and a negative ELISA HIV seropositivity test administered at a Military Entrance Processing Station became a requirement for entry into military service since that time (3,4). The period of time at risk of seroconversion during a year for those who seroconverted was assumed to be one-half the interval between the last negative ELISA test and the first positive ELISA test. Persons who had only one negative ELISA test were not included in the population at risk of seroconversion.

Age-adjustment was done by the indirect method using age-specific seroconversion rates for the total Navy and Marine Corps combined as the standard population rates in order to allow direct comparisons among sub-groups; 95% confidence intervals were calculated using the Poisson distribution (11).

HIV seroconverters were defined as persons with at least one negative ELISA screening test followed by two positive paired ELISA tests and two positive Western blot assays from

TABLE 1

Age-adjusted HIV seroconversion incidence rate per 1,000 person-years at risk by sex and race, active-duty Navy personnel, January 1986 - December 1988

| U.S. Navy | Number of seroconverters | Person-years at risk | Sero-conversion incidence rate per 1,000 person-years at risk | Age-adjusted sero-conversion incidence rate (95%CL) per 1,000 person-years at risk |
|------------|--------------------------|----------------------|---|--|
| White | 6 | | | |
| Men | 286 | 536,318 | 0.53 | 0.53 (0.47-0.60) |
| Women | 3 | 47,726 | 0.06 | 0.06 (0.01-0.16) |
| All | 289 | 584,044 | 0.49 | 0.49 (0.44-0.55) |
| Black | | | | |
| Men | 187 | 91,418 | 2.05 | 2.01 (1.73-2.32) |
| Women | 7 | 14,387 | 0.49 | 0.46 (0.18-0.94) |
| All | 194 | 105,805 | 1.83 | 1.79 (1.54-2.06) |
| Other | | | | |
| Men | 30 | 43,331 | 0.69 | 0.71 (0.48-1.01) |
| Women | 0 | 2,855 | 0.00 | 0.00 (0.00-1.22) |
| All | 30 | 46,186 | 0.63 | 0.60 (0.40-0.85) |
| All races | | | | |
| Men | 503 | 671,067 | 0.75 | 0.75 (0.68-0.82) |
| Women | 10 | 64,968 | 0.15 | 0.15 (0.07-0.27) |
| Total Navy | 513 | 736,035 | 0.70 | 0.69 (0.63-0.76) |

* Age-adjusted by the indirect method using age-specific rates for the total Navy and Marine Corps populations combined as the standard.

separate blood draws. The criterion for a positive Western blot was a specimen that exhibited at least two of three bands at p24, gp41, and gp120/160. ELISA testing to detect the presence of antibody to HIV in serum or plasma was done using Abbott laboratory's HTLV-III (HIV-I) Enzyme Immunoassay (EIA) test kit from October 1985 to November 1986; since that time, the Virgo Electro-Nucleonics Human T Lymphotropic Virus Type III ELISA test kit (Columbia, Maryland) has been used. Beginning in October 1985, the Navy has used the Biotech Research Laboratories Inc. (Rockville,

Maryland) Western blot assay methodology. Since May 1987 a Cambridge Bioscience Corporation Recombinant DNA EIA has been used to resolve indeterminate or discordant results.

Results

U.S. Navy

During the three-year period from 1 January 1986 to 31 December 1988, there were 513 active-duty Navy personnel who seroconverted from HIV negative to HIV positive (Table

TABLE 2
HIV seroconversion incidence rate per 1,000 person-years at risk, active-duty Navy personnel by age,
January 1986 - December 1988

| U.S. Navy | Number of sero- converters | Person-years at risk | Seroconversion incidence rate per 1,000 person-years at risk |
|------------------|----------------------------------|-------------------------|--|
| Whites | | | |
| 17-19 | 8 | 41,217 | 0.19 |
| 20-24 | 126 | 228,093 | 0.55 |
| 25-29 | 77 | 138,818 | 0.55 |
| 30-34 | 39 | 81,402 | 0.48 |
| 35-39 | 35 | 83,208 | 0.42 |
| 40+ | 4 | 11,306 | 0.35 |
| All | 289 | 584,044 | 0.49 |
| Blacks | | | |
| 17-19 | 2 | 9,061 | 0.22 |
| 20-24 | 93 | 48,977 | 1.90 |
| 25-29 | 62 | 25,773 | 2.41 |
| 30-34 | 25 | 13,174 | 1.90 |
| 35-39 | 12 | 8,154 | 1.47 |
| 40+ | 0 | 666 | 0.00 |
| All | 194 | 105,805 | 1.83 |
| Others | | | |
| 17-19 | 0 | 1,263 | 0.00 |
| 20-24 | 12 | 11,048 | 1.09 |
| 25-29 | 11 | 10,752 | 1.02 |
| 30-34 | 5 | 9,032 | 0.55 |
| 35-39 | 2 | 12,633 | 0.16 |
| 40+ | 0 | 12,432 | 0.00 |
| All | 30 | 46,186 | 0.65 |
| All races | | | |
| 17-19 | 10 | 51,540 | 0.19 |
| 20-24 | 231 | 288,118 | 0.80 |
| 25-29 | 150 | 175,342 | 0.86 |
| 30-34 | 69 | 103,609 | 0.67 |
| 35-39 | 49 | 103,995 | 0.47 |
| 40+ | 4 | 13,431 | 0.30 |
| Total Navy | 513 | 736,035 | 0.70 |



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TABLE 3

Age-adjusted HIV seroconversion incidence rate per 1,000 person-years at risk, by race and sex, active-duty Marine Corps personnel, January 1986 - December 1988

| U.S. Marine Corps | Number of seroconverters | Person-years at risk | Seroconversion incidence rate per 1,000 person-years at risk | Age-adjusted seroconversion incidence rate (95%CL) per 1,000 person-years at risk |
|-------------------|--------------------------|----------------------|--|---|
| White | | | | |
| Men | 28 | 178,947 | 0.16 | 0.16 (0.11-0.23) |
| Women | 1 | 7,525 | 0.13 | 0.13 (0.01-0.72) |
| All | 29 | 186,472 | 0.16 | 0.16 (0.11-0.23) |
| Black | | | | |
| Men | 36 | 44,254 | 0.81 | 0.81 (0.57-1.13) |
| Women | 0 | 2,855 | 0.00 | 0.00 (0.00-1.24) |
| All | 36 | 47,109 | 0.76 | 0.76 (0.53-1.06) |
| Other | | | | |
| Men | 4 | 17,114 | 0.23 | 0.24 (0.07-0.62) |
| Women | 0 | 749 | 0.00 | 0.00 (0.00-4.76) |
| All | 4 | 17,863 | 0.22 | 0.16 (0.04-0.42) |
| All races | | | | |
| Men | 68 | 240,315 | 0.28 | 0.29 (0.23-0.37) |
| Women | 1 | 11,129 | 0.09 | 0.09 (1.01-0.49) |
| Total Marines | 69 | 251,444 | 0.27 | 0.28 (0.22-0.36) |

1). The overall age-adjusted average annual seroconversion incidence rate in the Navy during the study-period was 0.69 (95% C.I. = 0.63-0.76) per 1,000 person-years at risk.

Age-adjusted incidence rates of seroconversion were 5.0 (95% C.I. = 2.5-11.7) times higher for men than for women in the Navy. Age-adjusted incidence rates of seroconversion were 3.7 (95% C.I. = 2.9-4.9) times higher for black men than for white men in the Navy. The rate for black women was 7.7 (95% C.I. = 1.1-94.0) times the rate for white women. While rates for women were based on very few seroconverters, this difference was statistically significant ($p < 0.05$).

The rate in men other than blacks or whites was not significantly different from white men, but was significantly lower than for black men ($p < 0.05$).

The incidence rate of seroconversion in whites is lowest in the 17-19 year age-group (Table 2, Figure 1). While the incidence rates in non-whites in the 17-19 year age-group were low, the lowest incidence rates were seen at ages 40+ (0.09 per 1,000 for both blacks and others). Incidence rates in all racial groups rise sharply in the 20-24 year age-range. Rates remain high through the 30-34 year age-range, then decline.

U.S. Marines

During the study period there were 69 active-duty Marine Corps personnel who seroconverted from HIV negative to HIV positive (Table 3).

The overall age-adjusted seroconversion rate in the Marine Corps of 0.28 (95% C.I. = 0.22-0.36) per 1,000 person-years at risk was significantly lower than the Navy rate of 0.69 (95% C.I. = 0.63-0.76) per 1,000 person-years. The number of women in the Marine Corps was so few that it precluded meaningful comparisons with the Navy. As in the Navy, the rate of seroconversion in black men was 5.1 times that for white men (95% C.I. = 2.5-10.3). The pattern of rates by age in the Marines is similar to the Navy (Table 4, Figure 2).

Discussion

It is difficult to assess the degree to which the findings of this study can be generalized to the U.S. population at large. The HIV seroconversion incidence rates in the Naval and Marine Corps populations are markedly different. These differences are not due to differences in case ascertainment or definition, since the blood collection and data analysis were

TABLE 4

HIV seroconversion incidence rate per 1,000 person-years at risk, active-duty Marine Corps personnel by age,
January 1985 - December 1988

| U.S. Marine Corps | Number of seroconverters | Person-years at risk | Seroconversion incidence rate per 1,000 person-years at risk |
|---------------------------|-----------------------------|-------------------------|--|
| Whites | | | |
| 17-19 | 0 | 26,568 | 0.00 |
| 20-24 | 16 | 94,588 | 0.17 |
| 25-29 | 7 | 32,672 | 0.21 |
| 30-34 | 1 | 16,070 | 0.06 |
| 35-39 | 5 | 14,880 | 0.34 |
| 40+ | 0 | 1,694 | 0.00 |
| All | 29 | 186,472 | 0.16 |
| Blacks | | | |
| 17-19 | 3 | 5,723 | 0.52 |
| 20-24 | 17 | 23,443 | 0.73 |
| 25-29 | 13 | 10,437 | 1.25 |
| 30-34 | 3 | 4,528 | 0.66 |
| 35-39 | 0 | 2,769 | 0.00 |
| 40+ | 0 | 209 | 0.00 |
| All | 36 | 47,109 | 0.76 |
| Others | | | |
| 17-19 | 1 | 30,134 | 0.33 |
| 20-24 | 2 | 10,302 | 0.19 |
| 25-29 | 1 | 2,815 | 0.36 |
| 30-34 | 0 | 1,110 | 0.00 |
| 35-39 | 0 | 591 | 0.00 |
| 40+ | 0 | 31 | 0.00 |
| All | 4 | 17,863 | 0.22 |
| All races | | | |
| 17-19 | 4 | 35,305 | 0.11 |
| 20-24 | 35 | 128,334 | 0.27 |
| 25-29 | 21 | 45,925 | 0.46 |
| 30-34 | 4 | 21,708 | 0.18 |
| 35-39 | 5 | 18,239 | 0.27 |
| 40+ | 0 | 1,933 | 0.00 |
| Total Marine Corps | 69 | 251,444 | 0.27 |

performed by the Navy for the Marine Corps.

The Navy may be more representative of the population at large than the Marine Corps. There are more than 100 major occupational categories in the Navy that cover nearly the entire spectrum of civilian occupations. The Navy provides medical care for itself and the Marine Corps, and, consequently, has a large medical component. Many other support services are represented in the Navy to a much greater extent than in the Marine Corps.

Reliable information regarding behavioral risk factors

(sexual practices and drug-use) is not available for either the Navy or Marine Corps populations. While seropositive personnel from both services are requested to fill out an anonymous personal history questionnaire which asks about risk factors, fewer than 10% of the questionnaires have been returned. As a consequence, discussion of differences in the prevalence of behavioral risk factors in these two populations would be speculative.

There are several factors that could contribute to an underestimation of the HIV seroconversion incidence in the

general population based on Navy incidence rates. Three of these factors are:

- Navy policies prohibiting homosexual behavior and intravenous drug use,
- self deferral from application to military service of individuals with behavioral risk factors, and
- exclusion of hemophiliacs from Naval service.

The prevalence of these risk factors is probably low in the Navy in comparison to some urban populations, but perhaps not below that which might be found in non-urban populations (with the exception of hemophilia). Although these factors could lead to an under-estimation of U.S. incidence based on Navy rates, other factors may lead to an over-estimation.

The Navy population is heavily weighted toward a young, single, mobile, and presumably sexually-active population as compared to the total U.S. population. This may be a factor which could lead to an over-estimation of the incidence rate of seroconversion in the general population, based on the Navy HIV experience.

The present study has several important strengths, however, including:

- nearly complete testing (97%) of the population, and
- inclusion of all persons testing seropositive from all sources of testing.

The results presented here are close to the Army estimation of 0.74 HIV seroconverters per 1,000 person-years to be presented at an international conference on AIDS in 1989 (personal communication). The seroconversion rate in the Navy population was much lower than that observed in an initially HIV seronegative cohort of 2,507 sexually-active homosexual men living in urban centers followed for six months (the Multicenter AIDS Cohort Study)(12). The six-month seroconversion rate in this population was 3.8% in 1985 (12).

The Uniformed Services provide a unique resource for the study of the incidence of seroconversion in a large, young, heterogeneous population. This study had nearly one million person-years of follow up. In the Navy, the yearly incidence rate of HIV seroconversion ranged from 0.00 per 1,000 person-years in women other than black or white, to 2.05 per 1,000 person-years in black men. The rate of seroconversion in black women, while based on only 7 cases, approached that seen in white men. Behavioral risk factors were not addressed in this study because of issues of information reliability and confidentiality in military service.

Accurate incidence rates of HIV seroconversion are needed to control this epidemic in the services and the general population. The incidence rates of HIV seroconversion for a well-defined population provided here can serve as baseline rates for monitoring the epidemic and for determining the effectiveness of prevention programs.

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